

EIC Milestones

EIC Task Force
Kick-Off Meeting
April 10, 2009

First Draft of EIC Milestones

- So far no 'official' list of EIC milestones
- First attempt to define milestones
 - ▶ general
 - ▶ e+p
 - ▶ e+A
 - ▶ detector related
- Need to be further refined and discussed
 - ▶ merging, more general, more specific ...
- Serve as a guide on our efforts
- Once in shape should also go to EIC IAC

General Milestones

Year/#	Milestone	Target Date	Critical
2009 eic1	Assemble a list of science questions that will drive the mission statement for an EIC, and a corresponding set of key measurements that will drive the machine requirements.	May 2009	Yes
2009 eic2	Define matrix of physics reach versus costs a. For the low energy option b. For the high energy option Related questions: Do we truly need positrons	2010	Yes
2009 eic3	What are the optimal beam energies a. For the low energy option b. For the high energy option	2010	Yes
2009 eic4	Develop answers to the main questions that will dominate the LRP process . Examples: <ul style="list-style-type: none"> • Is the EIC really complementary to Hera and the LHeC • What are the 1B\$ dollar science questions • Why can the EIC solve the spin puzzle, if the fixed target experiments, RHIC and 12GeV can not 	Spring 2012	Yes

e+A Milestones (I)

Year/#	Milestone	Target Date	Critical
2009 eA1	Develop the most promising methods to measure the gluon momentum distribution in nuclei and establish the strength and weaknesses of each. At a minimum: <ul style="list-style-type: none">•through F_2 scaling violation in DIS•through FL in DIS•through exclusive vector meson production in diffractive events•through 2+1 jets in DIS	Spring 2010	Yes
2009 eA2	Develop the most promising methods to measure the gluon space time distribution in nuclei and establish the strength and weaknesses of each approach	Fall 2010	Yes
2009 eA3	Develop measurements in hard diffractive events that provide insights into the nature of the pomeron		Yes
2009 eA4	Establish (theory, simulations) and document the key measurements that clearly manifest the saturation of gluon densities	Spring 2010	Yes

e+A Milestones (II)

Year/#	Milestone	Target Date	Critical
2009 eA5	Establish (theory, simulations) and document the key measurements that clearly manifest the existence of the Color Glass Condensate	Spring 2010	Yes
2009 eA6	Establish and document the key measurements that help to gain novel insight into the nature of confinement	Summer 2012	Yes
2009 eA7	Establish and document the key measurements that probe universality (ep, eA, pp, pA) and that help to gain novel insight into the existence of a universal “Fixed Point”	Spring 2011	Yes
2009 eA8	Develop the key measurement that gain novel insight into Parton Propagation (charm & beauty), and Energy Loss mechanism in nuclei and study to what extent they provide new insight into the physics of hadronization Key items: Fragmentation functions, jet studies	Fall 2010	Yes

e+A Milestones (III)

Year/#	Milestone	Target Date	Critical
2009 eA9	Develop the key measurement to study intrinsic charm		No
2009 eA10	Develop the key measurement to study the limits of factorization (eA/pA/ep/pp)		No
2009 eA11	Develop a simulator for eA collisions that allows to simulate DIS as well as diffractive events. Attempt to include models for the breakup of the nuclei	Summer 2009	Yes
2009 eA12	Develop key measurements to probe the partonic structure of nuclear forces Key items: coincidence measurements of correlated nucleon break-up	2012	No

EIC LDRD Proposal:

Realization of an eA Physics Event Generator

PI: Thomas Ullrich, Raju Venugopalan

Needs

- Success of the EIC is closely tied to the strength of the physics case for an e+A physics program
- e+A collision more complex than e+p
 - ▶ nuclear initial and final state effects (A, b dependence?)
 - ▶ amplification of gluon saturation (A, b dependence?)
- Broad range of compelling measurements
 - ▶ simple inclusive measurements in DIS \Leftrightarrow exclusive measurements in diffractive events
- An e+p simulator for e+A is not enough
 - ▶ Need to test models: linear QCD/DGALP versus non-linear QCD/saturation/CGC
 - ▶ Can we get a handle on b (multiplicity) ?
 - ▶ Nuclear breakup (incoherent diffractive events)
 - ▶ Parton energy loss in medium

Impact on: machine (\mathcal{L} , E_{beam})

detector (acceptance, PID, tracking)

Needs

- Success of the EIC is closely tied to the strength of the physics case for an e+A physics program
- e+A collision more complex than e+p

- E No such generator exists to-date

If we (EIC) do not pursue this it's not going to happen

- A

It is vital for the e+A program

- ▶ Nuclear breakup (incoherent diffractive events)
- ▶ Parton energy loss in medium

Impact on: machine (\mathcal{L} , E_{beam})

detector (acceptance, PID, tracking)

Requirements

The minimum requirements for an e+A generator are:

- Handle inclusive DIS as well as semi-inclusive and diffractive final states
- Reflect the nuclear geometry of various ions (inc. Uranium)
- Simulate initial (e.g. shadowing) and final state (E-loss, color transparency, medium modified hadronization) nuclear effects
- Simulate the breakup of the nucleus to allow for studies of b sensitivity of various measurements and energy deposition in ZDC
- Allow for the implementation of alternative models (e.g. CGC) to study the sensitivity to new physics
- Implements relevant QED effects like radiative corrections that may be significant for large nuclei

Needs lots of expertise (not available locally)

Some efforts so far (Matt, Cyrille) but to have something in time need massive effort

Proposal

- (i) hire a **postdoc** with expertise in this field and experience in event generators to write such a generator *and*
- (ii) augments his efforts by **inviting** known **experts** to BNL, each for several weeks or month, to work in collaboration with him on the program.

There are several candidates for (i) and (ii)

Who depends on choice of path:

- add e+p to existing pA/AA generator
- add A to existing ep generators

Costs: ~\$250k over 2 years for postdoc and visitors

N.B.: Possible collaboration with LHeC?